RFCA Stakeholder Focus Group
April 17, 2002
Meeting Minutes

INTRODUCTION AND ADMINISTRATIVE

A participants list for the April 17, 2002 Rocky Flats Cleanup Agreement (RFCA) Stakeholder Focus Group meeting is included in this report as Appendix A

Reed Hodgin of AlphaTRAC, Inc , meeting facilitator, reviewed the purpose of the RFCA Focus Group and the meeting rules Introductions were made.

AGENDA

Reed reviewed the agenda

- Agency Responses to RSALs Task 3 Report Peer Reviews,
- RESRAD and Risk Recalculations, and
- Uranium Surface RSAL Calculation and Draft Modeling Results

AGENCY RESPONSES TO RSALs TASK 3 REPORT PEER REVIEWS

Reed asked if there were further comments or requests regarding the latest version of the Radiological Soil Action Level (RSAL) Task 3 report and peer reviews before the document is finalized

The Focus Group had no further questions or comments Reed asked that in the event questions or comments arose, please forward them to Christine Bennett of AlphaTRAC and Christine would ensure that the agencies received them

RESRAD AND RISK RECALCULATIONS

The U S Environmental Protection Agency (EPA) made two presentations

1 Recalculated dose-based RSALs for Plutonium and Americium, and
2 Risk Recalculations Discussion

Recalculated Dose-based RSALs for Plutonium and Americium

Dose calculations were performed using the RESRAD 6 0 model for the RSALs *Draft Task 3 Report* Five exposure scenarios were addressed wildlife refuge worker, rural resident, open space user, office worker, and resident rancher Plutonium and

Americium activity concentrations in surface soil were calculated for a 25 millirem (mrem) annual dose Original results were summarized in pages 1 and 49 of the *Draft Task 3 Report Dose and Risk Calculations for Plutonium in Surface Soil Adjusted by Sum-of-Ratio Method (pCi/g)* and *Table V-2 Dose and Risk Calculations for Americium in Surface Soil Adjust by Sum-of-Ratios Method (pCi/g)*

These results were recalculated using a different adult soil ingestion value in the RESRAD 6 0 model

The presentation for the recalculations was organized into two sections

- Differences in Parameters, and
- Results New / Previous Sum of Ratios in picoCuries per gram (pCi/g)

Differences in Parameters

Changes in parameters resulted from comments from peer reviewers

Basically, all of the parameters that were used in all of the different scenarios were identical with one exception—a different parameter for the adult soil ingestion This new calculation used a uniform distribution ranging from 0 to 130 milligrams per day (mg/day) The old point estimate used was 100mg/day

Also, corrected was an inconsistency It was discovered that the soil ingestion needed different apportioning for the open space user and office worker scenarios For example, an adult open space worker may ingest up to 50mg of soil each day that they are on the site If they are only on the site for 2 hours, then the RESRAD inputs were adjusted to 50mg/day for a 2-hour visit for 100 days a year This adjustment resulted in a different answer

One reviewer commented that the risk equations did not have a provision for calculating full ingrowth of Americium As a result, the maximum value of Americium, which is 18 2%, was used instead of the measured value of 15 3% This added a level of conservatism

Results: New / Previous Sum-of-Ratios in pCi/g

The following results have been adjusted by sum-of-ratios and are the recalculated results for each scenario The recalculated result appears on the left-hand side **in bold** The earlier result appears on the right-hand side

Revised Dose Calculations for Plutonium and Americium in Surface Soil Adjusted by Sum-of-Ratios – pCi/g (25-mrem annual dose)

Scenario	Pu RSAL	Am RSAL
Wildlife Refuge Worker	**780**/862	**142**/132
Rural Resident – Adult	**232**/209	**42**/32
Rural Resident – Child	**251**/244	**46**/37
Open Space – Adult	**3617**/11797	**658**/1801
Open space – Child	**1205**/4842	**219**/739
Office Worker	**1598**/2289	**290**/350

A general trend was the relationship between Americium to Plutonium and the recalculations resulting in a higher RSAL, with the exception of the wildlife refuge worker This was due to the fact that the distribution was multiplied by a factor of 3 in order to assign the 130 mg/day of soil ingestion for 8 hours The RESRAD model would not convert certain data, so this was a forced input

Recalculated RSALs for the three CERCLA risk levels (i e , 10^{-4}, 10^{-5}, 10^{-6}) were not included in this presentation.

Summary

- Americium RSALs go up relative to Plutonium because of the higher equilibrium ratio
- The decrease in RSALs for open space user and office worker are consistent with the risk approach used previously, and
- The changes to the refuge worker and the rural resident values were not considered significant

Risk Recalculations Discussion

The EPA reviewed the changes to the Plutonium and Americium risk calculations As previously noted at the March 20, 2002 RFCA Focus Group meeting, the cancer slope factors were not representative of adult-only soil ingestion rates, as it was previously calculated using an averaged adult / child number called a "mixed slope factor " Revisions to the spreadsheets have been completed using the new adult-specific cancer slope factor provided by EPA Headquarters These revisions also included using point

estimate and probabilistic approaches for adult soil intake rate. New risk-based point estimate and probabilistic RSALs for scenarios were provided as a part of the presentation and act as amendments to the following tables in the *Draft Task 3 Report dated 10/22/01*

- Table V-3 Risk Based Probabilistic RSALs for Individual Radionuclides for the Rural Resident **replaced by Table V-3a. Risk-based Point Estimated and Probabilistic RSALs for Individual Radionuclides for the Rural Resident**
- Table V-4 Risk-Based Probabilistic RSALs for Individual Radionuclides for Wildlife Refuge Worker **replaced by Table V-4a. Risk-based Point Estimate and Probabilistic RSALs for Individual Radionuclides for the Wildlife Refuge Worker**
- Table V-5 Risk Based Deterministic RSALs for Individual Radionuclides for Office Worker (pCi/g) **replaced by Table V-5a. Risk-based Point Estimate RSALs for Individual Radionuclides for the Office Worker**
- Table V-6 Risk Based Deterministic RSALs for Individual Radionuclides for Open Space User (pCi/g) **replaced by Table V-6a. Risk-based Point Estimate RSALs for Individual Radionuclides for the Open Space User**

The risk-based RSALs for rural resident (Table V-3a) and wildlife refuge worker (Table V-4a) were estimated using both point estimate and probabilistic approaches In a point estimate approach, the RSAL represents a soil concentration that is protective of the reasonable maximum exposed individual In a probabilistic approach, a range of values, described as probability distributions, were input to the equations and the output is a range or distribution of RSALs that reflect variability in population For the probabilistic approach, EPA defines the 90-99th percentile of a risk distribution as the recommended reasonable maximum exposed range, with the 95th percentile as the starting point for risk-decision making Because RSAL calculations are inversely related to risk calculations, the reasonable maximum exposed range for RSALs corresponds to the 1st through 10th percentiles, with a recommended starting point at the 5th percentile.

The recalculated result appears on the left-hand side **in bold** The earlier result appears on the right-hand side

Table V-3a. Risk-based Point Estimate and Probabilistic RSALs for Individual Radionuclides for the Rural Resident.

Radionuclide	Target Risk	Probabilistic RME Range[1]			Point Estimate
		10th	5th	1st	
Am-241	1E-04	145(135)*	93 (87)	39 (37)	70
	1E-05	14 (13)	9 (9)	4 (4)	7
	1E-06	1 4 (1 3)	0 9 (0 9)	0 4 (0 4)	0 7
Pu-239	1E-04	459(369)	306(248)	148(37)	130
	1E-05	46 (37)	31 (25)	15 (13)	13
	1E-06	4 6 (3 7)	3 1 (2 5)	1.5 (1 3)	1 3

[1] 10th to 1st percentiles of RSAL distribution corresponds to 90th to 99th percentiles of risk distribution
*Values in parenthesis from 10/22/01 draft Task 3 report

Table V-4a. Risk-based Point Estimate and Probabilistic RSALs for Individual Radionuclides for the Wildlife Refuge Worker.

Radionuclide	Target Risk	Probabilistic RME Range[1]			Point Estimate
		10th	5th	1st	
Am-241	1E-04	435(351)*	376(306)	295(243)	291
	1E-05	43 (35)	38 (31)	29 (24)	29
	1E-06	4 3 (3 5)	3 8 (3 1)	2.9 (2 4)	2 9
Pu-239	1E-04	1464 (758)	1150 (649)	700 (496)	665
	1E-05	146 (76)	115 (65)	70 (5)	66
	1E-06	14 6 (7 6)	11 5 (6 5)	7 0 (5 0)	6 6

[1] 10th to 1st percentiles of RSAL distribution corresponds to 90th to 99th percentiles of risk distribution
*Values in parenthesis from 10/22/01 draft Task 3 Report

The risk-based RSALs for office worker (Table V-5a) and open space user (Table V-6a) were estimated using a point estimate approach instead of a deterministic approach

The recalculated result appears on the left-hand side **in bold** The earlier result appears on the right-hand side

Table V-5a. Risk-based Point Estimate RSALs for Individual Radionuclides for the Office Worker

Radionuclide	Target Risk	Point Estimate
Am-241	1E-04	**369*(511)**
	1E-05	**37** (51)
	1E-06	**3.7** (5)
Pu-239	1E-04	**800** (725)
	1E-05	**80** (73)
	1E-06	**8 0** (7 0)

*Values in parenthesis from 10/22/01 Task 3 Report

Table V-6a. Risk-based Point Estimate RSALs for Individual Radionuclides for the Open Space User

Radionuclide	Target Risk	Point Estimate
Am-241	1E-04	**364** (955)*
	1E-05	**36** (96)
	1E-06	**3 6** (9 6)
Pu-239	1E-04	**1126** (1257)
	1E-05	**113** (126)
	1E-06	**11.3** (12 6)

A Focus Group member asked if the adult cancer slope factor was designed to represent an entire lifetime EPA said that it represented 18 to 65 years of age

A Focus Group member asked about stewardship and questioned why the Focus Group was not using the most conservative scenario The Colorado Department of Public Health and Environment (CDPHE) stated that the end state was being viewed with an eye on what would happen over time With this in mind, areas that were subject to erosion had a role in making decisions about remediation CDPHE also mentioned that these types of discussions were being held in the Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments

EPA added that additional calculations were not done on the resident rancher scenario. The RAC group conducted an evaluation, but their methods of calculating mass loading were very different, and the results were considered very, very high by this Focus Group A similar and representative scenario (rural resident) was recalculated and the differences between the RAC resident rancher and rural resident were considered The RAC resident rancher was higher than the rural resident by a factor of 5 due to the fact that the RAC used 8,000mg/m^3 for an annual mass loading average, and the rural resident scenario was modeled using a 24-hour mass loading of 660mg/m^3

RESRAD V6.0 URANIUM RSAL RESULTS FOR ROCKY FLATS

This presentation was organized in thirteen sections

1 Aspects of the Uranium Problem
2 General Approach,
3 Parameter Sensitivity Investigation
4 Pathway Sensitivity
5 Addressing Uncertainty in Area and Depth of Contamination
6 Addressing Uncertainty in Isotopic Ratios for Uranium
7 Addressing Toxicity
8 Depleted Uranium
9 20% Enriched Uranium
10 Dose Coefficients
11 Plant Uptake Fraction
12 Results Before Toxicity Adjustments
13 Results Adjusted for Toxicity
14 Summary

Aspects of the Uranium Problem

- Small "hot spots" of uncertain area,
- Primarily subsurface,
- Site has worked with both depleted (DU) and enriched (EU) forms of Uranium,
- Possible wide range of ratios of three isotopes U238, U235, U234, and
- Toxicity to human kidney must also be considered

There are small "hot spots" of a wide variety of Uranium mixtures, which are widely dispersed and are not currently well characterized So far, there exists enriched Uranium, which is processed to create U235 isotope used for weapons and depleted Uranium, which is the residual amount after the Uranium is processed. Uranium contamination is primarily subsurface as it has been buried

Due to the wide variety of Uranium mixtures, a wide range of ratios are needed for three isotopes U238, U235, and U234 This made assessing (calculating) human health affects a complex problem Uranium is a toxic metal and toxicity to the human kidney must be considered as well. It is possible to have radiological criteria that are protective, but still not be protected from toxicity

General Approach

- Model wildlife refuge worker and rural resident (adult / child) scenarios,
- Use same parameter values and distributions as for Plutonium RSALs if possible,
- Investigate selected additional parameters for sensitivity (area and depth),
- Address uncertainty conservatively

Currently, three scenarios were modeled wildlife refuge worker and the rural resident (adult and child) Similar inputs were used in terms of site description and meteorology as used for Plutonium Since Uranium has many more gamma rays than Plutonium, exposure is still a great concern even though Uranium is buried Uncertainties were being addressed in a conservative way

Parameter Sensitivity Investigation

- Area of contamination—very sensitive for small hot spots,
- Depth of contamination—sensitive up to about 40 centimeters for Uranium,

- Plant root uptake fraction for Uranium—a wide range of variability observed

A full-scale sensitivity analysis was not conducted due to the work already completed for Plutonium Areas of contamination were reviewed, and it was concluded that areas smaller than 100/m^2 needed to be considered a sensitive parameter, as they generally were characterized as hot spots Research shows that at the depth of contamination beyond 40 centimeters, the surface soil shielded the gamma rays effectively In terms of the plant root uptake fraction, it was discovered that for Uranium, the uptake was orders of magnitude higher than Plutonium due to Uranium's behavior while in the soil

Pathway Sensitivity

- Plant ingestion—dominant for U234,
- External exposure—dominant for U238 and U235,
- Inhalation—always less than 1% of dose

The pathways will remain the same for all three scenarios soil ingestion, inhalation, external exposure and the rural resident all included plant ingestion The scenarios were modeled using the different isotopes U234, U235, and U238 Plant ingestion is affected primarily by U234 U234 does not contribute to the external exposure External exposure is primarily from U235 and U238 Soil ingestion contamination from the three isotopes showed very little contribution For the inhalation pathway, the modeling results have always demonstrated less than 1% of dose, indicating trace amounts of Uranium

Addressing Uncertainty in Area and Depth of Contamination

- Model a hypothetical large area (5 acres),
- Model hypothetical surface contamination,
- Select 50 centimeters as hypothetical depth of contamination

A lot of uncertainty exists, so a decision was made to model a hypothetical area of around five acres This is consistent with the parameter used for the rural resident for Plutonium To try and model surface contamination, assuming the Uranium was able to move from subsurface to surface, 50 centimeters was determined to be the depth of contamination for the purposes of calculation

Addressing Uncertainty in Isotopic Ratios for Uranium

- Compute RSAL for each isotope (U238, U235, and U234),
- Compute sum-of-ratios RSALs for both DU and EU (bounding cases),
- Select the most restrictive RSAL as a single criterion,
- Express as total Uranium in mass units (mg/g)

A RSAL and sum-of-ratios were calculated for each isotope for two Uranium cases depleted Uranium and 20% enriched Uranium These calculations were based on areas of known Uranium contamination and do not represent areas where only background Uranium exists Based on these calculations, the most restrictive case would be chosen to represent an RSAL for Uranium Micrograms per gram (mg/g) was used instead of picoCuries per gram (pCi/g) as a convenient way to measure total uranium in terms of mass per unit of soil instead of in terms of activity Micrograms per gram enabled a comparison between depleted Uranium and enriched Uranium When measuring in pCi/g, the isotopic ratio was required and became too complicated for this analysis In addition, measuring in mg/g was useful for analyzing and comparing toxicity

Addressing Toxicity

For sum-of-ratios RSALs for depleted Uranium and enriched Uranium

- Find percentage of dose due to ingestion (plant ingestion plus soil ingestion),
- Back calculate to annual intake, average daily intake,
- Compare with the reference dose for Uranium (RfD=3 0 ug/kg/day),
- Reduce soil action level so reference dose is not exceeded

To assess toxicity, a formula was used to back calculate annual intake of DU and EU to an average daily intake of depleted and enriched Uranium The percentage of dose via plant or soil ingestion was calculated first using a computer model This dose corresponded to millirem radiological dose Then the percentage of dose was divided by the ingestion dose coefficient (ICRP 72) expressed in millirems per pCi This was converted to micrograms This represents the annual intake, which is used to calculate average daily intake This result was compared with safety standards and the reference dose If the safety standard or reference dose for toxicity was exceeded, the soil action level was reduced because radiological criteria was not protective enough

Reed noted that reference dose is not associated with radioactivity, it is associated with heavy metal toxicity

Depleted Uranium

The following chart showed the difference in percentages of the different isotopes of EU and DU by mass

Depleted Uranium
1 picoCurie = 2 5 micrograms

Isotope	% by Mass	% Activity
U238	99 75	70
U235	25	1
U234	0005	29

U234 makes up a very small amount of DU by mass (0005), but represents 29% by activity This is due to the very short half-life relative to U235 and U238

20% Enriched Uranium

U234 is still a very small amount by mass, but now has 90% of the activity The range of mass in terms of pCi was great for EU and DU

20% Enriched Uranium
1 picoCurie = 111 micrograms

Isotope	% by Mass	% Activity
U238	79 95	4
U235	20	6
U234	05	90

Dose Coefficients

- Taken from ICRP 72,
- Applicable to members of the public,
- Age specific—adults and 1-year old child,
- Only one choice for ingestion coefficient (conservative),
- Used default Type M for inhalation

The dose coefficients from ICRP 72 are age-specific For these calculations, the data that are represented are an adult and a 1-year old child A level of uncertainty was factored

into the dose coefficient to help keep the coefficient conservative The variables that were considered for uncertainty were solubility and form Uranium tends to be reasonably insoluble, but the dose coefficient uses moderate solubility Also, if the Rocky Flats Site was not sure what the chemical form of Uranium was at the time of exposure, then using type moderate (Type M) for the inhalation parameter was suggested It was emphasized that inhalation only represents 1% of the dose according to sensitivity studies

Plant Uptake Fraction

- Represents fraction of Uranium in soil taken up through plant roots,
- Wide variability observed in studies,
- Influenced by many factors,
- Used a broad distribution in the RESRAD model,
- Modeled more conservatively than the RESRAD default

Plant uptake fraction represents a fraction of Uranium if the soil is taken up through a plant's roots After reviewing several studies, the Working Group identified a wide variability in the amount of Uranium that could be taken up through a plant's roots. Since there was such a complicated relationship with plant uptake, the Working Group made a decision to use a broad distribution for that parameter in RESRAD This was more conservative than the default value in RESRAD It was observed that these results were three times higher than the RESRAD default at the 95th percentile These results were reviewed by Dr Ward Wicker, and he confirmed that they were conservative

Results before Toxicity Adjustments

The next two charts, titled *Results (micrograms/grams) Before Toxicity Adjustments* and *Results (micrograms/grams) Adjusted for Toxicity* were calculated using total Uranium It was found that total Uranium was easier to measure and less expensive to study than isotopic Uranium For three scenarios, RSALs were calculated For EU, the RSAL is greater than the two resident scenarios The RSALs are calculated and expressed in micrograms/grams It was discovered that scaling of the RSALs was necessary in order to meet toxicity criteria

Results (micrograms/grams)
Before Toxicity Adjustments

Scenario	DU RSAL	EU RSAL
Rural Resident - Adult	619	31

Rural Resident - Child	692	35
Wildlife Refuge Worker	3268	225

Results Adjusted for Toxicity

Based on the adjusted toxicity results, it was decided that RSAL for the rural resident would be 31mg/g for EU, and for the wildlife refuge worker, the RSAL would be 225mg/g for EU. Both criteria are based on a radiological annual dose of 25 millirem because of the Uranium being enriched

Results (micrograms/grams)
Adjusted for Toxicity

Scenario	DU RSAL	EU RSAL
Rural Resident - Adult	225	31
Rural Resident - Child	124	35
Wildlife Refuge Worker	3163	225

Summary

- The most restrictive criterion for rural resident scenario is 31 mg/g,
- The most restrictive criterion for wildlife refuge worker is 225 mg/g,
- Both criteria are radiologically based on a 25-millirem annual dose for 20% enriched Uranium, and
- The input parameters were based on many conservative assumptions

General Discussion

A member of the Focus Group asked for a description of the different forms of Uranium at Rocky Flats and how they were represented in the model. The Focus Group was informed that this information was not easy to extract from the datasets, but consulting with different studies on the subject, the RSALs for Uranium at Rocky Flats reasonably represent the wide range of variability found in the studies The description of the different forms of Uranium at Rocky Flats would be published in a pathway summary

One Focus Group member pointed out that the RSAL for EU would result in very high clean up costs because of the potential for cleaning up areas where natural background levels exceed this RSAL

The RSALs Working Group has been tasked with finalizing the Task 3 Report The final report will address the Focus Group discussions and the responses to the peer reviews

The Focus Group was informed that end state discussions and policy discussions concerned with RSALs would be answered in a different forum

The CDPHE acknowledged all the participants for their hard work CDPHE stated that Rocky Flats has accelerated its current cleanup schedule and the focus will be on surface contamination cleanup in the risk range of 10^{-5} for the refuge worker

ADJOURN

The meeting adjourned at 6 00 p m

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Appendix A
Participants List

15/15